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much that is in the chapter must be mastered through the instructor's exposition, but we must make proper recognition when we meet with a treatment of vectors that continually keeps before the student the knowledge that vectors *can be used* and that makes the theorem that the curl of a gradient is zero appear as a matter of common sense (even to a pure mathematician). This is done by means of a well-explained example of a curl. The chapter closes with suggestive, rather than complete, proofs of Stokes's theorem and the formulas for small displacements, with incidental discussion of vector fields and potential.

An appendix provides a careful but broad selection and description of texts to be recommended for the student's further study in mathematics and mathematical physics.

WILLIAM DEW. CAIRNS.

PROBLEMS AND SOLUTIONS.

B. F. FINKEL, CHAIRMAN OF THE COMMITTEE.

PROBLEMS FOR SOLUTION.

ALGEBRA.

398. Proposed by R. D. CARMICHAEL, Indiana University.

In the equation $x^3 + \alpha x + \beta = 0$, α is an integer divisible by p^2 and β is an integer divisible by p , p being a prime number. Prove that β is divisible by p^3 if the equation is reducible.

399. Proposed by W. H. BUSSEY, University of Minnesota.

A borrows from B \$1,500 and pays back \$34 a month for 63 months. If the last payment closes the account, what rate of interest has A been paying?

400. Proposed by C. N. SCHMALL, New York City.

Sum the series

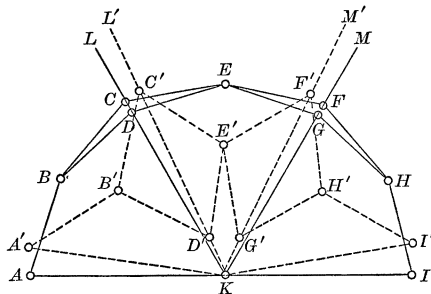
$$1 + 2x + 3x^2 + 4x^3 + \dots$$

(BROMWICH, *Infinite Series*, p. 129, ex. 1.)

GEOMETRY.

427. Proposed by F. CAJORI, Colorado College.

In S. Gross's linkage for trisection of angles, shown in the figure (KL' and KM' being the



trisectors of $A'KI'$), C is fixed on KL , also F on KM ; at starting, C and D coincide, also F and G ;

D slides on KL , G slides simultaneously on KM ; if E moves along a perpendicular to AI erected at K , find the loci of B and D .¹

428. Proposed by R. D. CARMICHAEL, Indiana University.

On a given chord of a circle as a base construct a right triangle with vertex outside of the circle such that its hypotenuse shall be bisected by its point of intersection with the circle. Are ruler and compasses sufficient to construct a triangle whose hypotenuse shall thus be divided in any ratio whatever?

429. Proposed by JOHN A. BIGBEE, Little Rock, Ark.

In the trihedral angle $V-ABC$, the face angle AVB is bisected by the straight line VD . Is it true that the angle DVC is less than, equal to, or greater than, half the sum of the angles AVC and BVC , according as $\angle CVD$ is less than, equal to, or greater than 90° ?

430. Proposed by DANIEL KRETH, Wellman, Iowa.

The distance between A and B is always a feet. A travels along a straight path at the rate of v_1 miles per hour, and B starts at the same time in the path behind A and travels in a curve at the rate of v_2 miles per hour. How far will B travel to reach the path in front of A , and how far to reach the path again behind A ?

CALCULUS.

350. Proposed by R. P. BAKER, University of Iowa.

Find a general formula for $\frac{d^ny}{dx^n}$ in terms of $\frac{d^ky}{dt^k}$ and $\frac{d^kx}{dt^k}$.

351. Proposed by C. N. SCHMALL, New York City.

In the ellipse $(x^2/a^2) + (y^2/b^2) = 1$, are given the eccentricity e and the angle ϕ which the normal at any point P (on the curve) makes with the major axis. If R is the radius of curvature at P , prove that

$$R = \frac{a(1 - e^2)}{(1 - e^2 \sin^2 \phi)^{3/2}}.$$

352. Proposed by RICHARD P. LOCHNER, Philadelphia, Pa.

At point P there are n foxes. At Q , a rods south of P , there is a dog. The dog and the foxes are freed at the same instant and run at uniform speeds. Some of the foxes run east, some north, some west and some south. The dog runs first toward the foxes that ran east and always points toward them. He captures one of them and then instantly pursues the pack that ran north. In like manner, when he has captured one of them, he pursues those that ran west, then those that ran south, and then begins over again by pursuing the ones running east. If r is the ratio of the dog's speed to that of a fox, what is the total length of the n curves of pursuit?

(Generalization of a problem published in 1859 in the *Mathematical Monthly*.)

MECHANICS.

284. Proposed by C. N. SCHMALL, New York, N. Y.

A cylindrical vessel standing upright on a horizontal plane is kept constantly full of water by an automatic device. Determine at what height in its side a small orifice should be made, so that the water may spout through it to the greatest horizontal distance on the plane. What difference in the result when the cylinder stands on a shelf of known height above the plane?

Note. This problem may have an application in the case of automatic sprinklers.

285. Proposed by RICHARD P. LOCHNER, Philadelphia, Pa.

A ladder 25 ft. long, weighing 120 lb., leans against a vertical wall. Its foot is prevented from slipping on the plane by a peg driven into the ground 7 ft. from the wall. If a man weighing 150 lb. is one-third the way up the ladder, what is the reaction on the peg, the ground, and the wall?

¹ Linkages for the trisection and multisection of angles are described in *Verhandl. des 3. Internationalen Mathematiker-Kongress in Heidelberg, Leipzig, 1905*, pp. 492-496; *Zeitschr. f. Math. u. Physik*, Vol. 49, 1903, pp. 342-347; *Mémoires de la société r. d. sciences de Liège*, 2. série, T. XX, 1898; *Ueber spezielle alg. und trans. Kurven*, von G. Loria (uebers. v. Schütte), Leipzig, 1902, *Sextrix-Kurven*, pp. 316-323.